Learning Technologies
Project Plan

2000

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High Performance Computing and Communications Program

Project Plan

Learning Technologies (LT) Project

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Learning Technologies

Project Plan FY00

Table of Contents

Figures

Tables

Learning Technologies
Project Plan FY00

1. INTRODUCTION

The Learning Technologies (LT) Project is a multi-center activity managed by the HPCC LT Project Office at the NASA Ames Research Center (ARC). LT funds activities that use the National Information Infrastructure (that is, the Internet) and other technologies to foster reform and restructuring in math, science, computing, engineering, and technical education. LT activities fall under the Educational Technology category of NASA's Education Program. Over the years LT has generated dozens of legacy projects.

LT uses an on-line presence showcasing NASA's inspiring mission, unique facilities, and specialized workforce in conjunction with the best emerging technologies to promote excellence in America's educational system. LT will maximize the delivery and impact of our education programs by engaging our research and contractor communities in the use of state-of-the-art educational technologies, and by developing partnerships with the education community. LT will continue to promote computer and network literacy. In the next few years LT will expand its suite of technology applications to showcase multisensory and multimedia educational products.

1.1 The LT Vision Statement:

"LTP promotes effective use of NASA information and knowledge for education and life long learning"

NASA's Strategic Plan states that: "NASA is an investment in America's future. As explorers, pioneers, and innovators, we boldly expand frontiers in air and space to inspire and serve America and to benefit the quality of life on Earth."

The Learning Technologies Project will make a significant contribution to this vision by using leading-edge technologies to deliver NASA mission content to learning environments across the nation.

1.2 The LT Mission Statement:

"LTP is NASA's leader in educational technology"

One of four strategic outcomes from the "Vision, Mission, and Goals" section of the NASA Strategic Plan is to "involve the educational community in our endeavors to inspire America's students, create learning opportunities, and enlighten inquisitive minds."

To support the NASA Strategic Plan and NASA's Educational Technology Program Implementation Plan, LT researches emerging technologies and develops these technologies into high-quality and affordable learning environments connecting educators with NASA missions. Our intent is to support these educators in their own educational goals, in the goals of the educational systems in which they work, and in their efforts to improve those systems.

LT has a strong focus on multimedia, multisensory, internet-based technologies. It leverages off of innovative state-of-the-art science. Many of LT's high-level milestones will develop new capabilities from these sources.

1.3 LT Goals:

The goal of the Learning Technologies Project is:

"To research and develop products and services that use NASA information and that facilitate the application of technology to enhance the educational process for formal and informal education and lifelong learning."

The goal supports the NASA Education Division goal for Educational Technology as seen at http://education.nasa.gov/implan/fig1.htm :

"To research and develop products and services that facilitate the application of technology to enhance the educational process for formal and informal education and life long learning."

This Education Technology goal directly contributes to National Priorities in Educational Excellence as noted on page 9 of the 1998 NASA Strategic Plan with 1999 Interim Adjustments:

"We involve the educational community in our endeavors to inspire America's students, create learning opportunities, and enlighten inquisitive minds."

2. LT OBJECTIVES

The objectives of the Learning Technologies Project will support enhancements in the way educators teach and will significantly contribute to the Agency's Strategic Outcomes in Education. The following project objectives are designed to support the Customer Impact and Customer Usability objectives, and to meet the associated LT performance goals in the HPCC Program Plan.

- Prototype/establish advanced technologies that serve as a catalyst for learning environment use of engineering and scientific data
- Demonstrate integrated learning technology products in relevant educational environments
- Production-ready breakthrough technologies that serve as a catalyst for learning environment use of engineering and scientific data
- Develop prototype of revolutionary multisensory, multimedia technology for education
- Establish impact on NASA's education mission through the demonstration of prototype revolutionary multisensory, multimedia systems for education
- Enable sustained use of LT technologies by educational community

3. CUSTOMER DEFINITION AND ADVOCACY

The primary customer of LT is the educational community. Specifically the students and the teachers comprise the target audience of our product scope, including people concerned with lifelong learning. LT endeavors to include academia where possible as they are the primary mechanism to pre-service training.

The process used to ensure customer advocacy include four mechanisms:

- Evaluation
- Advisory Board Reviews
- Conference Interactions
- Dissemination & Feedback

Each of our tasks contains an element of evaluation. This process ensures that we are reviewing our work at the activity level and that what is presented to the educational arena is on target.

Advisory Board Reviews occur every six months to ensure that our project is producing a product that is consistent with the views of academia and industry.

Conference interaction gives us face-to-face access to teachers and allows us to gather their views and input directly.

Dissemination of products is a primary delivery mechanism to reach teachers and students. User survey forms are completed by recipients of our data and returned to the project.

4. PROJECT AUTHORITY

Ames Research Center is the Lead Center for LT. Supporting centers are;

- Dryden Flight Research Center (DFRC)
- Goddard Space Flight Center (GSFC)
- Jet Propulsion Laboratory (JPL)
- Lyndon B. Johnson Space Center (JSC)
- Glenn Research Center (GRC)
- Langley Research Center (LaRC)
- John F. Kennedy Space Center (KSC)
- George C. Marshall Space Flight Center (MSFC)
- Stennis Space Center (SSC)

5. MANAGEMENT

In general this project is made possible through the collaboration of civil servants, contractors, universities, corporations and other government agencies. The purpose of this

section is to describe our project management approach to implementing tasks and disseminating project requirements.

5.1 LT Program Management

NASA's LT program is managed from the Learning Technologies Project Office (LTPO) at ARC that reports to the HPCC Program Office at ARC. LT accomplishes its mission through specific tasks conducted by regional NASA centers, grants, cooperative agreements, NASA contracts and sub-contracts.

5.2 LT Project Management

The LT Project Office is supported by the LT Manager, the Deputy LT Manager, and a small project support staff. LT Project Management is also comprised of a Regional Outreach Center (ROC) Manager, Strategic Tasks (ST) Manager, the New Solicitation Manager, the Technology Development Manager, the grants office Contract Officer (CO) and Contracting Officer Technical Representative (COTR), and Procurement Office Cooperative Agreement COs and COTRs. LT management is responsible for organizing, planning, and executing the LT Project Plan. This includes integrating LT activities across the Agency. The Project Office is responsible for managing and disseminating the fiscal budget at the seven-digit RTOP level.

5.3 LT Task Management

Each LT task has its own Task Manager who is responsible for managing the task. The LT manager will oversee all tasks and working groups.

Task Management consists of the regional outreach center managers and the Principal Investigators (PI) for the grants and cooperative agreements. The respective organizational structures for each of these levels will be defined in subsequent sections. Task Management also includes the use of NASA procurement vehicles.

5.4 LT Organizational Structure for FY00

The support of all levels of management for the cooperative agreements, grants, NASA contracts and the supporting centers is crucial to the success of LT. These structures, as well as roles and responsibilities are spelled out below. Major management decisions require the concurrence of HPCC management and the NASA Education Division.

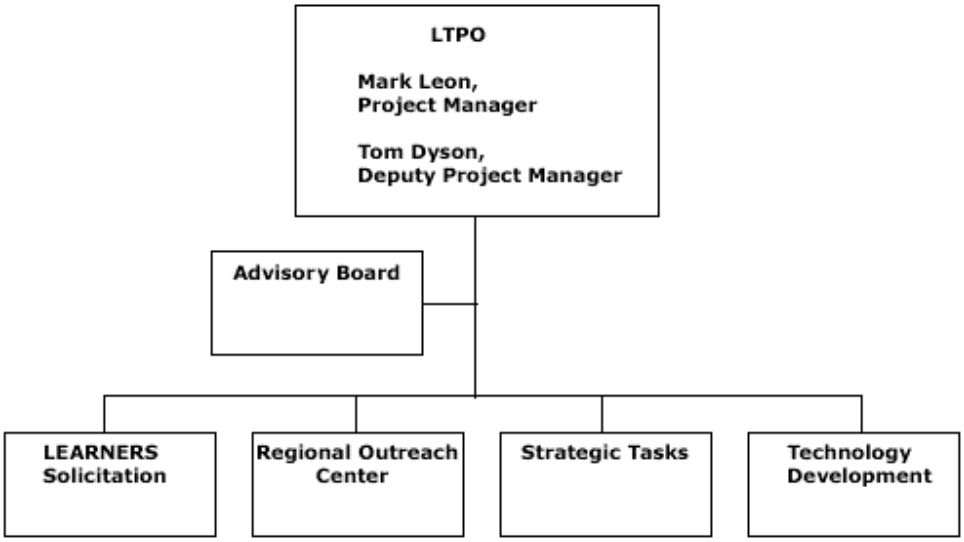
The LEARNERS Solicitation is managed out of GSFC and is composed of seven grants and cooperative agreements.

The Regional Outreach Centers are coordinated by a contractor through Raytheon and consist of ten NASA centers.

The Strategic Tasks consist of Interagency Agreements, Memorandums of Understanding, Executive Orders and other formal mechanisms to accomplish project milestones.

The Technology Development Group is responsible for implementing LT testbeds to accomplish project milestones.

Figure 1: LT Organizational Chart for FY00



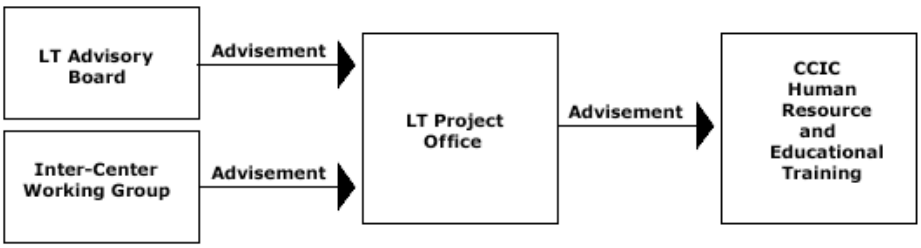
5.4.1 L T Project Office Roles and Responsibilities (WBS 1.0)

The LT Project Manager reports to the HPCC Program Manager located at ARC. This component represents Work Breakdown Structure (WBS) 1.0. The Project Manager is responsible for the overall management of LT including: implementation of the research and education programs; maintenance of the financial integrity of the project; constructing and maintaining the technology necessary to manage the project (databases, Web sites and mail lists); and preparing, submitting, and presenting reports, reviews, evaluations and projections to senior management.

As delegated by the Learning Technologies Project Manager, the Deputy Project Manager's responsibilities include, but are not limited to general support of the Project Office and LT collaboration with academia, industry and other federal agencies. These responsibilities are discharged by the LT Deputy Project Manager with assistance from the LT staff. Some requirements will be achieved by matrixing support from other LT managers.

5.4.2 Project Advisement

Figure 2: Project Office Advisement



The Learning Technologies Project Office will use the InterCenter Working Group (ICWG) and the LT Advisory Board as its review board. The purpose of the ICWG will be to internally review and determine that the technology and applications being developed are of sound direction. The purpose of the Advisory Board will be to externally ensure that the technologies and applications being developed are of value to our customers

LT also holds a seat on the Committee for Computing, Information, and Communication (CCIC) on Educational Training and Human Resources (ETHR). The CCIC is part of the National Coordinating Office (NCO) which is attached to the White House.

5.4.3 ICWG Advisement

The ICWG issues are open to anyone interested in the activities of this working group. The voting members of the ICWG are the ten Education Division officers from our participating centers, the LT Project Manager, the LT Deputy Manager, the ten LT outreach center managers, the LEARNERS solicitation manager, the Strategic Task Manager, and the Technology Development Manager. These voting members make decisions through consensus during the ICWG meeting.

Within the ICWG there are typically three or four active micro working groups at any given time. Currently the existing working groups are as follows:

* Multimedia Streaming Group (MSG) chaired by A. Federman (PO) and supported by ARC, Classroom Of The Future (CoTF), GSFC, JSC, LaRC, & GRC.

* Evaluation Working Group (EWG) chaired by M. McCarthy (DFRC) , supported by ARC & LaRC.

* Special Events Working Group (SEWG) chaired by M. León (PO), supported by ARC, GSFC, LaRC, & GRC.

5.4.4 LT Advisory Board - Roles and Responsibilities

The Learning Technologies Project is committed to ensuring the technical and educational excellence of its products and services. To validate the quality of the project, LT seeks outside assessment and guidance. Because LT is committed to implementing changes that enhance the project's quality, feedback from the LT Advisory Board will be used to focus the coming year's activity.

Potential Advisory Board members were invited to participate in April 1998; Feedback received from the Board is being implemented in FY00.

The LT Advisory Board is made up of seven leading-edge experts in the field of computing and education. These individuals serve a term of two fiscal years.

The general role of the LT Advisory Board is to examine Learning Technologies tasks, products, and services and offer advice and guidance.

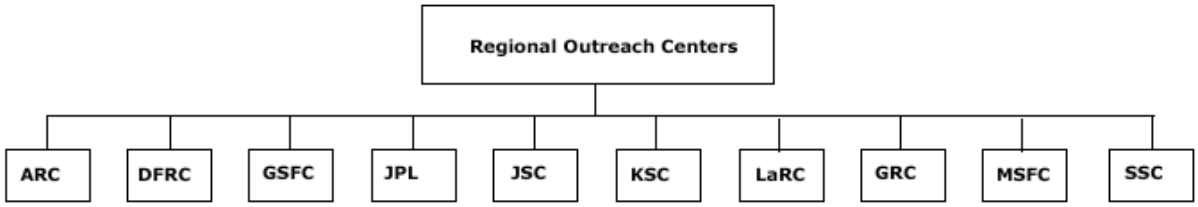
Specifically, the LT Advisory Board will:

- Review annual project plans submitted by the LT Project Office.
- Review yearly proposals submitted by LT Regional Outreach Centers.

- Conduct an annual review of LT for technical and educational merit.
- Help to shape any new solicitations offered by LT.
- Identify activities which merit greater or lesser emphasis.

5.4.5 LT Regional Outreach Center Projects - Roles and Responsibilities

Figure 3: Regional Outreach Center Organizational Chart



This activity represents WBS 2.0. The Regional Outreach Center (ROC) Manager is responsible for the coordination of activities of the NASA Regional Outreach Center Tasks within the ten LT regional NASA centers. The ROC Manager will keep in regular communication with the regional centers to assure continued technical progress along with compliance with the financial and technical reporting requirements of the Project Office. The ROC Manager will also provide resource advocacy, as necessary, to the Project Office. Supporting NASA Centers will maintain a Regional Outreach Center Manager as a point of contact for the ROC Manager to prepare reports and briefings on task implementation, and to oversee activities at the center. This task manager will have the responsibility of managing the budget allocation from HQ as directed by LT management.

Each ROC champions one or two specific thrusts. The following centers are distinctive in the following areas:

- ARC for Communicating NASA Science via Internet Multimedia
- DFRC for Evaluation of the LTP
- DFRC for WWW Learning Modalities
- GSFC for Curriculum Development Tools with Earth and Space Science
- JPL for Curriculum Development Tools with Space Science
- JSC for WWW Tools for Teachers
- KSC for Curriculum Development Tools with Human Exploration and Development of Space
- LaRC For Curriculum Development Tools with Aeronautics and Space Transportation Technology
- GRC For Curriculum Development Tools with Aeronautics and Space Transportation Technology
- GRC for Distance Learning

- MSFC for Curriculum Development Tools with Earth Science
- SSC for Curriculum Development Tools with Earth Science

5.4.6 LT Enterprise Liaisons - Roles and Responsibilities

The Project Manager and Deputy Project Manager are responsible for the coordination of activities between the LT Enterprise Liaisons and the four NASA Enterprise Education Officers. They will coordinate with the lead for education in each NASA Enterprise, including NASA Education Division Enterprise (Code FE) Liaisons.

5.4.7 LT Solicitation - Roles and Responsibilities

This section represents WBS 3.0. Every three years LT solicits and awards several grants and cooperative agreements consistent with our goals and objectives. These awards are executed through a formal competitive process. These awards are considered sub tasks. In FY99 seven new awards were made. The name of this solicitation was “Leading Educators to Applications, Research and NASA-unique Educational Resources in Science” (LEARNERS).

Purpose of the LEARNERS Solicitation

- Stimulate the educational community with NASA-related content.
- Develop Internet-based curricula that facilitate the educational process.
- Develop Internet-based technologies that facilitate the educational process.
- Utilize emerging information technologies.
- Create products that can be used in the formal classroom within 3 to 5 years.
- Produce products that can be affordably replicated and easily disseminated.
- Empower the American educator in the formal classroom setting.
- Measure the effectiveness of these products on learning in the classroom.

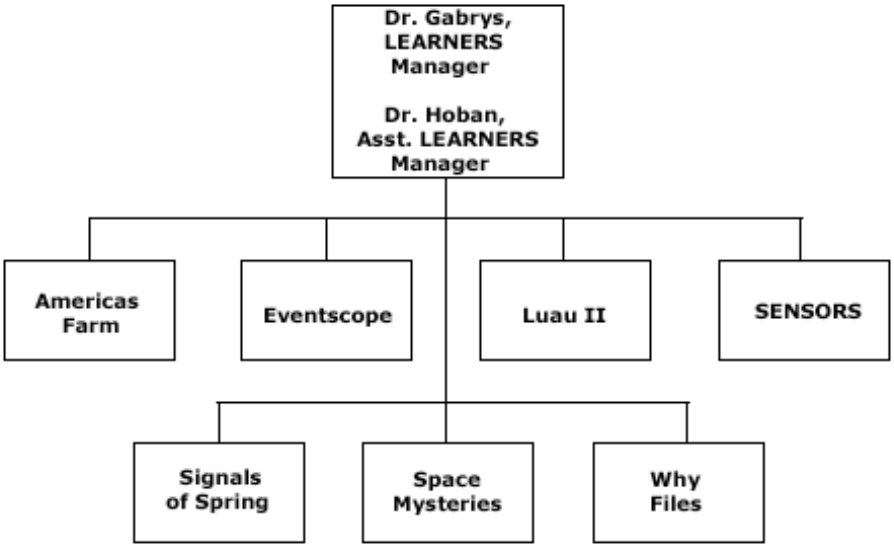
LEARNERS Evaluation Criteria

- Innovative integration and application of current and emerging information technologies
- Evaluation plan for measuring effectiveness on learning in the classroom
- Identification and adherence to specific national education standards
- Identification of specific NASA-related content
- Integration of NASA content with broader science and/or engineering
- Pre-service and in-service teacher training components
- Addressing underserved communities
- Serving students with special needs
- Extent and quality of cost sharing

LEARNERS Awards for FY99

- Eventscope under Carnegie Mellon University
- Why? Files under Christopher Newport University
- Luau II under Penn State University
- Space Mysteries under Sonoma State University
- SENSORS under Tufts University
- America's Farm under University of Nebraska
- Signals of Spring under U.S. Satellite, Incorporated.

Figure 4: New Solicitation Organizational Chart



In FY02, the LEARNERS Manager will be responsible for generation of the LEARNERS II Solicitation Notice, the proposal conference, the proposal peer review, the award process and the management of the new solicitation.

The Manager will collect monthly reporting from each of the awarded projects for the purpose of reporting technical progress and milestone status to management. LEARNERS I will extend until FY03.

5.4.8 LT Strategic Tasks - Roles and Responsibilities

Figure 5: Strategic Tasks Organizational Chart

This section represents WBS 4.0. The Strategic Tasks (ST) Manager is responsible for any legacy tasks as well as grants and cooperative agreements that have entered into no-cost extensions. Projects that concluded at that time have been either continued under separate commercial or other agency funding, or they have been archived on an LT server (no funded work has been lost). In some cases, where funding has been completely terminated, LT is supporting the archiving and maintenance of this work. The ST Manager will collect monthly reporting from each of the active projects for the purpose of reporting technical progress and milestone status to management.

The ST will coordinate Executive Order 13111. They will maintain close communications with NASA HQ to ensure that all Statements of Requirements are being met and that HQ funding is being executed for this project. They will work with other federal agencies which are partnered with this agreement through the jointly signed MOU, specifically the US Coast Guard, the US Navy, the FAA and NASA.

The ST Manager will work under the guidelines of Interagency Agreements and industrial partnerships to achieve project milestones. In addition the ST Manager will collect data on the Legacy Tasks.

5.4.9 LT Technology Development - Roles and Responsibilities

The Technology Development (TD) Manager will oversee several areas of project development which impact all tasks inside of LT. These technologies are designed to support the implementation of LT milestones. They are also intended to be mechanisms for dissemination.

6. TECHNICAL SUMMARY

This section is divided by WBS by general task assignment. This section includes the financial allocation of these requirements to be developed and maintained.

6.1 WBS 1.0 (LTPO) Technical Breakout [$340,000]

Program Office Infrastructure (funded at $120,000)

The LT Taxes are a financial responsibility of the LT project with respect to Ames Research Center and the HPCC Program Office. LT also funds the taxes required for the ARC regional project.

Learning Technologies Project Office (funded at $250,000)

The LT Project Office support staff maximizes the delivery and impact of NASA online education programs. The Project Office explores emerging technologies and engages LT customers in the use of these educational technologies. The Project Office provides technology dissemination through development and later, presentations and demonstrations. It also assists the LT Project Manager in developing partnerships with the greater educational community. The project office is comprised of the Deputy Project Manager, and a technical assistant. The project utilizes $10,000 to fund cell phones, pagers, and computer supplies.

Learning Technologies Regional Conference (Funded at $20,000)

The LT Regional Conference facilitates the interactions of all LT participants.

6.2 WBS 2.0 (ROC's) Technical Breakout [$2,015,000]

Learning Technologies ICWG (funded at $80,000)

Management of the ICWG is an integral component of LT. This position also coordinates monthly reports, major educational events with Code FE and dissemination of LT products into the mainstream educational community.

ARC Learning Technologies Regional Outreach Center (Funded at $500,000)

Sharing NASA: Sharing NASA is a suite of projects which use network technology to make NASA programs accessible to students by connecting them in an exciting, interactive way with NASA scientists, engineers and others in math- and science-based careers. As we continue to develop our expertise in conducting these projects, we will also continue to spread the word among NASA organizations about our capabilities for educational outreach.

Learning Technologies Channel: This year the LT Project intends to continue operation of the Learning Technologies Channel (LTC). The LTC provides educators and the general public with a location on the Internet that allows them to participate in live events such as lectures, conferences, virtual field trips, and online courses.

DFRC Learning Technologies Regional Outreach Center (Funded at $150,000)

The Dryden Learning Technologies Project centers on the Web-Enhanced Learning Environment Strategies (WELES). The WELES were developed as part of a three-year educational research project with the Pennsylvania State University. This is the final year of this educational research. Next year, we intend to reinitiate our evaluation of NASA Web sites intended for educational use.

GSFC Learning Technologies Regional Outreach Center (Funded at $160,000)

The Goddard Space Flight Center (GSFC) Education Office, through its curriculum support component of the NASA and GSFC education frameworks, is charged with providing materials that support both national standards and state curricular frameworks, as well as incorporating the knowledge being generated through NASA enterprises.

JPL Learning Technologies Regional Outreach Center (Funded at $310,000)

Telescopes In Education (TIE) Program: The TIE program enables students of all cultural backgrounds and economic status, including those with physical disabilities, to increase their knowledge of astronomy, astrophysics, and mathematics; improve their computer literacy; and strengthen their critical thinking skills. TIE makes it possible for young people to conduct actual research, make discoveries in the areas of astronomy and astrophysics, and even publish their independent discoveries in appropriate science journals or the popular press.

Project SPACE Program—Sun, Planets, Asteroids, Comets, Exploration: The Project SPACE Program is a NASA/Jet Propulsion Laboratory educational technology program which integrates advanced computer technology, complex scientific data sets and a variety of scientific technologies into educational curriculum resources, models, simulations and classroom activities that support the national reform efforts in science and mathematics education. Project SPACE educational curriculum resources are designed for Middle and Secondary School Educators and Students.

JSC Learning Technologies Regional Outreach Center (Funded at $215,000)

The JSC LT Regional Project provides affordable networking technology to a variety of school environments to enrich the K-12 education process. It develops and distributes unique network applications that promote the technology and use of the National Information Infrastructure, and it disseminates NASA information, particularly math and science materials.

KSC Learning Technologies Regional Outreach Center (Funded at $50,000)

Virtual Science Mentor Project: The Kennedy Space Center's Virtual Science Mentor (VSM) project seeks to increase the number of mentors at KSC by 28 mentors (43%) and make the expertise of scientists and engineers available to schools throughout the state of Florida. Using state-of-the-art desktop videoconferencing equipment, KSC scientists and engineers will integrate with 65 classrooms throughout the state and mentor students using Internet-based curriculum, provide support for the Sunshine State Standards of Education, judge science fairs, coordinate and evaluate science projects, introduce and reinforce the use of educational technologies and increase the awareness of NASA education programs and initiatives.

Space Team Online: Space Team Online concentrates on the people of NASA involved in diverse careers who contribute to the space shuttle and space station programs. The project involves close collaboration with Kennedy Space Center and Johnson Space Center.

LaRC Learning Technologies Regional Outreach Center (Funded at $230,000)

Distance Learning: In FY00, the LaRC LT seeks to make LT training and NASA content easily accessible to educators, students, and the general public at any time of the day, regardless of their location. Common topics for discussion at many LT meetings are the issues of scalability, dissemination, and training related to LT projects. This element addresses all three of these concerns, and the results of this project are anticipated to be of benefit to LT projects at other NASA centers, in addition to the primary K-12 audience.

Interactive Projects: The LaRC LT will continue to develop strategic collaborations with NASA researchers and the educational community in a variety of areas to develop self-sustaining online projects, learning resources, and communications methods which support NASA's educational outreach efforts and expose students to unique NASA information and research. Some of the proposed activities include Aero Design Team Online, EarthKAM, Atmospheric Sciences, Robotics, CON^{2}ECT video series, Kids' Corner and NASA/CNES.

GRC Learning Technologies Regional Outreach Center (Funded at $220,000)

Educational Technology Applications: The educational technology applications, or content, developed by the NASA Lewis LT, focuses on software simulations and Web-based information and activities. Simulations of aeronautics-related concepts are created, along with grade-appropriate lessons that prompt students to discover basic scientific principles or to engage in problem-solving activities.

Widespread Dissemination: The NASA Lewis LT uses various methods to disseminate information about the content developed and the research completed. These methods include videoconferencing, use of the Learning Technologies Channel, programming over WVIZ-TV, Cleveland's Public Broadcasting Station, through participation at conferences and publications.

MSFC Learning Technologies Regional Outreach Center ($50,000)

The Marshall Space Flight Center LT Regional Project—the Earth System Science Education Pilot Testing and Dissemination Project—will conduct a pilot test of a set of Earth and space science resources developed in support of NASA's Earth Science Program and being made available on the World Wide Web as part of the FY00 Goddard Space Flight Center LT Proposal. It will also develop a new set of K-4 Earth and space science resources for the Web in support of goals and objectives of the NASA Earth Science Enterprise, utilize a network of teacher training sites established as part of the Alabama Research and Education Network, use the Internet as a major communication vehicle for the dissemination of Earth and space science curricular support materials, and assist in the development of a resource bank of Earth and space science activities using Internet Web sites linked to the resources of the Earth and space science directorates at NASA/Goddard and at the NASA/MSFC Global Hydrology and Climate Center (GHCC).

SSC Learning Technologies Regional Outreach Center ($50,000)

The Stennis Space Center LT Regional Project proposes the development and implementation of a one (Carnegie) unit, Web-delivered, high school science course called Spatial Information Sciences. Stennis Space Center is the Lead Center for Commercial Remote Sensing and is responsible for implementing the NASA HQ directed Workforce

Development Education and Training Initiative. This initiative will establish world-class remote sensing academic and research centers of excellence in Mississippi, and will thereby address the critical remote sensing workforce shortage, enabling the growth of the industry in Mississippi, and removing one of the major roadblocks for industry growth across the nation.

6.3 WBS 3.0 (LEARNERS) Technical Breakout [$1,370,000]

LEARNERS Project (funded at $1,170,000) [funded at 1,370 in FY01]

The LT Cooperative Agreement Notice attracts and procures approximately 7 projects that will integrate the Internet and other information technologies to direct the unique knowledge that flows from NASA's aeronautics, space and Earth system research into the K-12 classroom. Collectively, these projects will represent NASA Enterprises. Seven Agreements are being funded, including one senior manager at .6 FTE and an assistant at .15 FTE. The remaining funds are used for travel and conference support of the LEARNERS project.

6.4 WBS 4.0 (ST) Technical Breakout [$50,000]

Strategic Tasks (Funding determined by IA & Code FE indirect tasks)

Strategic Tasks takes emerging technology from the Technology Development group and other LT tasks and deploys it to other agencies, academia, the corporate sector and other NASA projects.

6.5 WBS 5.0 (TD) Technical Breakout [$225,000]

Technology Development (Funded at $225,000)

The Digital Media Test Bed Project is responsible for developing a test bed that can serve 5000 streams to schools and students across the nation. It includes a project scientist at 1.0 FTE and utilizes funds for the procurement of streaming software and server maintenance.

7. SCHEDULES

The LT Office shall approve all schedules and schedule modifications. Section 6 is a technical break down of tasks inside of LT. It is broken down by WBS as it relates to the management components. In addition, funding elements were identified by task. The resources section will generalize the tasks into 506 authority. The following sections discuss the milestones as they support the program plan. Section 7.5 outlines the relationship between the milestones, the WBS, the 506 authority, the task and subtask structure. For later-year milestones, the evolution of this technology has not yet been assigned to the WBS or tasks.

7.1 LT Major Milestones

The HPCC program contains seven PCA milestones. LT plays a role in four of them.

Table 1: HPCC LT PCA Milestones

Milestones	Due Date
PCA-4 Develop component technologies for usability	**9/04**
PCA-5 Demonstrate integrated HPCC technologies	**9/02**
PCA-6 Demonstrate significant engineering, scientific, and educational impacts from integrated HPCC technologies	**9/05**
PCA-7 Establish sustainable and wide-spread customer use of HPCC Program technologies	**9/06**

7.2 LT Program Milestones

The Learning Technologies Project is responsible for six program milestones. Milestone 6.4 is the combined responsibility of NREN and LT. Milestone 4.1 contributes directly to milestone 4.2. In milestone 4.1, ten technologies are targeted with the intention that five of these will mature into presentable technologies for milestone 4.2. Milestone 5.2 utilizes components developed in milestone 4.2 to act as the foundation for milestone 6.4. In milestone 6.4, the project integrates all of these prototype components into classroom-ready technology. These four milestones are considered LT's immersive technology thrust. Milestone 5.2 demonstrates dissemination of LT products. It feeds directly into milestone 7.3 and establishes a sustainable user base for NASA information utilizing LT technology. These two milestones comprise LT's dissemination thrust.

Table 2: HPCC LT Program Milestones and Metrics

Milestones	Due Date	Output Metrics
4.1 Prototype/establish advanced technologies that serve as a catalyst for learning environment use of engineering and scientific data. (LT)	9/00	Five prototype technology or application advances providing internet-based multimedia interactive tools addressing national education standards.
4.2 Production-ready breakthrough technologies that serve as a catalyst for learning environment use of engineering and scientific data (LT)	9/02	Five production-ready technology or application breakthroughs providing internet-based multimedia interactive tools addressing national education standards.
4.4 Develop prototype of revolutionary multisensory, multimedia technology for education. (LT)	9/04	Prototype technology for education with visual, auditory, motion and haptic interfaces and utilizing digital libraries and artificial intelligence.
5.2 Demonstrate integrated learning technology products in relevant educational environments. (LT)	9/01	Developed interactive multimedia technologies distributed to at least 10,000 learning environments such as schools, museums and science centers, community centers and aerospace education organizations.
6.4 Establish impact on NASA's education mission through the demonstration of prototype revolutionary multisensory, multimedia systems for education. (LT/NREN)	9/05	Establish classroom-ready prototype technologies for education with visual, auditory, motion and haptic interfaces and utilizing digital libraries and artificial intelligence. NREN will develop a distance-learning application utilizing adaptive networking technologies.
7.3 Enable sustained use of LT technologies by educational community. (LT)	9/05	Technologies or applications shall be infused as a tool to enhance the learning in a content area or multidisciplinary setting in at least 1,000 learning environments such as schools, museums and science centers, community centers

		and aerospace education organizations.

7.3 LT Project Milestones

LT has 31 project milestones. These milestones are achieved by the various tasks reporting to LT.

Table 3: LT Project Milestones and Metrics

Milestones	Due Date	Output Metrics
4.1.1 Prototype telepresence technology utilizing telescopes and education.	9/00	Initiate a site in the southern hemisphere.
4.1.2 Prototype telepresence technology utilizing robotics and education.	8/00	Initiate project on a continent outside of North America.
4.1.3 Prototype three-dimensional modeling software over time for education.	5/00	Initiate 4-D aerodynamics airflow modeling software which deploys 3-D graphics over time.
4.1.4 Prototype three-dimensional modeling software using stereo imagery for education.	9/00	Initiate software based on data from planetary missions or simulated missions.
4.1.5 Prototype simulation software for space exploration missions tied to education.	7/00	Initiate simulation software based on the exploration of space.
4.1.6 Prototype simulation software for space station missions tied to education.	5/00	Initiate simulation software using the Space Station as the central staging ground.
4.1.7 Prototype space station simulation software with haptic interfaces tied to education.	5/00	Initiate simulation software using haptic interfaces.
4.1.8 Prototype life sciences simulation software with haptic interfaces tied to education.	8/00	Initiate life science simulation software using haptic interfaces.
4.1.9 Prototype cutting-edge interactive on-line course over the internet accredited by a formal university supporting	1/00	Initiate on-line course supporting the hearing-impaired.

hearing-impaired.		
4.1.10 Prototype cutting-edge, interactive on-line course over the internet accredited by a formal university supporting visually-impaired.	9/00	Initiate on-line course supporting visually-impaired.
4.2.1 Produce telepresence technology for education.	3/01	Produce one telepresence technology.
4.2.2 Produce three-dimensional modeling software for education.	10/01	Produce one modeling software package.
4.2.3 Produce simulation software based on NASA science for education.	7/01	Produce one simulation software package.
4.2.4 Produce simulation software with haptic interfaces tied to education.	4/01	Produce one simulation software package with haptic interface.
4.2.5 Produce cutting-edge interactive on-line course for the sensory-impaired.	1/01	Produced one course.
4.4.1 Solicit and implement LEARNERS II agreements with industry & academia. (LT)	5/03	Initiate new cooperative agreements or grants under the LEARNERS II.
4.4.2 Select Human Exploration of Space grant.	5/03	Award one grant.
4.4.3 Select Space Science grant.	5/03	Award one grant.
4.4.4 Select Aerospace Technology grant.	6/03	Award one grant.
4.4.5 Select Earth Science Grant.	603	Award one grant.
4.4.6 Select one NASA Enterprise generic Grant.	6/03	Award one grant.
4.4.7 Develop 3-D applications with viewing	1/04	Initiate three 3-D tools.

glasses for education.		
4.4.8 Develop dual haptic glove technology.	5/03	Initiate two haptic tools.
4.4.9 Develop voice recognition interfaces for education.	2/04	Initiate one voice interface tool.
4.4.10 Develop digital library interfaces for educational interfaces.	10/02	Initiate five digital library tools.
4.4.11 Develop state-of-the-art audio applications.	6/03	Initiate two audio tools.
5.2.1 Update LT's 1998 database.	1/01	Authenticate 5000 schools.
5.2.2 LT Internet Curriculum enhancement Kit II	10/01	Distribute to 2000 schools.
5.2.3 New School Partnerships through LT projects	12/00	Add 1000 schools to partnership.
5.2.4 LT Internet Curriculum enhancement Kit III	8/01	Distribute to 2000 schools.
6.4.1 Establish impact of classroom-ready prototype technologies for education with visual interfaces.	6/04	Integrate one technology with visual interfaces into prototype.
6.4.2 Establish impact of classroom-ready prototype technologies for education with auditory interfaces.	2/04	Integrate one technology with auditory interfaces into prototype.
6.4.3 Establish impact of classroom-ready prototype technologies for education with motion and haptic interfaces.	4/04	Integrate one technology with motion and haptic interfaces into prototype.
6.4.4 Establish impact of classroom-ready prototype technologies for education utilizing digital libraries.	12/03	Integrate one technology utilizing digital libraries into prototype.
6.4.5 Establish impact of classroom-ready prototype	8/04	Integrate one technology utilizing artificial intelligence into prototype.

technologies for utilizing artificial intelligence.		intelligence into prototype.
6.4.6 Integrate classroom-ready prototype component technologies for education and establish impact.	5/05	Integrate all five component technologies into one interface into prototype.
7.3.1 Survey LT school's database.	6/03	Survey all 10000 schools in LT's Database.
7.3.2 Develop a five-point matrix establishing a sustainable period of use.	8/02	Develop matrix.
7.3.3 Authenticate schools using LT technology.	6/05	Catalog 1000 schools using LT products over a sustained period of two years.

7.4 LT Task Milestones

HPCC LT Task project milestones are listed in the Task project plans. These plans are on file at the LTPO.

7.5 LT cross cut Reference

The schedules are tracked by milestone and referenced by Work Breakdown Structure as well as through funded components.

Table 4: Milestone Broken Into WBS & Guideline & Task

PCA	Program Milestone	Project Milestone	Work Breakdown Structure	506 Guideline	Task	Sub-Task
4						
	4.1					
		L4.1.1	2	JPL	ROC JPL	TIE
		L4.1.1	5	ARC	LTPO TD	Remote Conn.
		L4.1.1	4	ARC	LTPO ST	SoTie
		L4.1.2	2	JPL	ROC JPL	TIE
		L4.1.2	4	ARC	LTPO ST	SoTie
		L4.1.2	4	ARC	LTPO ST	Victoria
		L4.1.2	3	GSFC	LEARNERS: SENSORS	Online
		L4.1.2	3	GSFC	LEARNERS: Event Scope	SS Activities
		L4.1.3	2	GRC	GRC ROC	Visualization SW
		L4.1.3	3	GSFC	LEARNERS: Event Scope	3-D Modeling
		L4.1.4	4	ARC	LTPO ST	IMG 3-D Modeling
		L4.1.5	4	ARC	LTPO ST	Victoria
		L4.1.5	4	ARC	LTPO ST	Haptic Research
		L4.1.5	3	GSFC	LEARNERS: SENSORS	SS Activities
		L4.1.5	2	GRC	GRC ROC	Visualization SW
		L4.1.6	2	LaRC	LaRC ROC	Web Technology
		L4.1.6	4	ARC	LTPO ST	Haptic Research
		L4.1.6	2	JPL	JPL ROC	SPACE
		L4.1.7	4	ARC	LTPO ST	Haptic Research
		L4.1.8	4	ARC	LTPO ST	Haptic Research
		L4.1.9	3	ARC	LTPO TD	Multimedia Backbo
		L4.1.9	3	ARC	LTPO ST	Online College Gra
		L4.1.9	3	JSC	JSC ROC	Online Courses
		L4.1.10	3	ARC	LTPO TD	Multimedia Backbo
		L4.1.10	3	ARC	LTPO ST	Online College Gra
		L4.1.10	3	JSC	JSC ROC	Online Courses
	4.2					
		L4.2.1	2,3,4,5	ARC, JPL, GSFC	LEARNERS, ROC's, TD, ST	
		L4.2.2	2,3,4,5	ARC, GRC, GSFC	LEARNERS, ROC's, TD, ST	
		L4.2.3	2,3,4,5	ARC, JPL, LaRC, GSFC, GRC	LEARNERS, ROC's, TD, ST	
		L4.2.4	2,3,4,5	ARC	LEARNERS, ROC's, TD, ST	
		L4.2.5	2,3,4,5	ARC, JSC	LEARNERS, ROC's, TD, ST	
	4.4					
		L4.4.1	3	GSFC	LEARNERS II	
		L4.4.2	3	GSFC	LEARNERS II	
		L4.4.3	3	GSFC	LEARNERS II	
		L4.4.4	3	GSFC	LEARNERS II	
		L4.4.5	3	GSFC	LEARNERS II	
		L4.4.6	3	GSFC	LEARNERS II	
		L4.4.7	2,4,5	ARC, GRC, GSFC	ROC, LTPO	
		L4.4.8	2,4,5	ARC	ROC, LTPO	
		L4.4.9	2,4,5	ARC	ROC, LTPO	
		L4.4.10	2,4,5	ARC	ROC, LTPO	
		L4.4.11	2,4,5	ARC, JSC	ROC, LTPO	
5						
	5.2					
		L5.2.1	1	ARC	LTPO	1998 PCA Data Bas

PCA	Program Milestone	Project Milestone	Work Breakdown Structure	506 Guideline	Task	Sub-Task
		L5.2.2	1	ARC	LTPO	Internet Kit II
		L5.2.3	2	ARC	ROC ARC	LTC
		L5.2.3	2	ARC	ROC ARC	Quest
		L5.2.3	2	ARC	ROC ARC	Sharing NASA
		L5.2.3	2	DFRC	ROC DFRC	WELES
		L5.2.3	2	GRC	ROC GRC	Internet Technologies
		L5.2.3	2	GRC	ROC GRC	Virtual Speaker Bureau
		L5.2.3	2	GSFC	ROC GSFC	Ambassador Outreach
		L5.2.3	2	JPL	ROC JPL	SPACE
		L5.2.3	2	KSC	ROC KSC	Online Mentoring
		L5.2.3	2	LaRC	ROC LaRC	Enterprise Outreach
		L5.2.3	2	MSFC	ROC MSFC	ES Activities
		L5.2.3	2	SSC	ROC SSC	Curriculum Development
		L5.2.3	3	GSFC	LEARNERS: America's Farm	Enterprise Outreach
		L5.2.3	3	GSFC	LEARNERS: Event Scope	SS Activities
		L5.2.3	3	GSFC	LEARNERS: Luau II	Aerospace Activities
		L5.2.3	3	GSFC	LEARNERS: SENSORS	ES Activities
		L5.2.3	3	GSFC	LEARNERS: Signals of Spring	ES Activities
		L5.2.3	3	GSFC	LEARNERS: Space Mysteries	SS Activities
		L5.2.3	3	GSFC	LEARNERS: Why?Files	Enterprise Activities
		L5.2.3	4	ARC	LTPO ST	Tahoe Plan
		L5.2.3	4	ARC	LTPO ST	Executive Order 13111
		L5.2.3	4	ARC	LTPO ST	HQ Code F
		L5.2.3	5	ARC	LTPO TD	Multimedia Backbone
		L5.2.3	5	ARC	LTPO TD	Remote Connectivity
		L5.2.3	4	ARC	LTPO ST	Aeronautics Logs
		L5.2.3	4	ARC	LTPO ST	Spa. Sta. Simm. & Haptic
		L5.2.3	1	ARC	LTPO	VIP Demonstrations
		L5.2.3	5	ARC	LTPO TD	Breakthrough Prototypes
		L5.2.3	4	ARC	LTPO ST	Victoria
		L5.2.3	4	ARC	LTPO ST	SoTie
		L5.2.3	4	ARC	LTPO ST	IMG 3-D Modeling
		L5.2.3	4	ARC	LTPO ST	Neural Networking
		L5.2.3	4	ARC	LTPO ST	Life Science & Haptics
		L5.2.3	4	ARC	LTPO ST	Data Base Project
		L5.2.4	4	ARC	LTPO ST	LT CD III
6						
	6.4					
		L6.4.1	1,2,3,4,5	ARC, GRC, GSFC		
		L6.4.2	1,2,3,4,5	ARC, JSC, GSFC		
		L6.4.3	1,2,3,4,5	ARC, GSFC		
		L6.4.4	1,2,3,4,5	ARC, GSFC		
		L6.4.5	1,2,3,4,5	ARC, JSC, GSFC		
		L6.4.6	1,2,3,4,5	ARC, GSFC		
7						
	7.3					
		L7.3.1	1	ARC	LTPO	
		L7.3.2	1	ARC	LTPO	
		L7.3.3	1	ARC	LTPO	

7.6 LT Metrics

LT Project Metrics grow out of the guiding principles, goals, and outcomes discussed earlier. LT shall use the Education Division Computer Aided Tracking System (EDCATS) as its formal method of data collection. Information from the monthly reports (below) will be summarized by the Regional Centers and entered into EDCATS. The Project Office will also make independent entries as appropriate.

Table 5: LT Metrics and Related Outcomes

Metric	Related Outcome(s)
1) Awards and recognition received	• LT is recognized by the academic and industrial communities
2) On-line: Web statistics (hits, Kb transferred, unique addresses) per month	• LT is visible and findable • Well-defined technical training path • Large-scale integration of LT into classrooms
3) Off-line: Number of conferences and other external activities	• LT is visible and findable
4) Number of "referenceable" papers submitted by LT and affiliates	• Raised level of math, science, engineering, and technology awareness
5) Number of schools and underserved schools served by LT projects	• Raised level of math, science, engineering, and technology awareness

Each center must make a reasonable effort to meet these five metrics. The agency is likely to judge the project by its numerical success in these areas.

Metric 1 will be calculated at one major award for every $100K spent on the project rounded to the nearest whole number. If a project budget is $150K, 1.5 prestigious awards, rounded to two prestigious awards will be required to meet this metric.

Metric 2 will be calculated at a minimum of one hit per dollar. If a center has a budget of $300K, the metric would be at least 300,000 hits for the year. In general most projects far exceed this metric in a single month, however the lower boundary has been set.

Metric 3 will measure one major conference or public activity for every $100K rounded to the nearest whole number. If a project has a budget of $220K per year, it is expected to support 2.2 events, rounded to two events.

Metric 4 will be calculated at one paper for every $100K rounded to the nearest whole number. A center receiving $500K would be expected to produce at least five papers during the year.

Metric 5 will be calculated at three schools for every $10K. A center with $20K would be expected to have data on six schools that it has supported in some fashion. Note this could be as simple as preparing an Internet kit for the school or doing an Internet activity. In general this can be a very low level of personal involvement, but enough for the school to know that NASA is providing it with something.

Table 6: LT FY00 Target Metrics

Metric	ARC	DFRC	GSFC	KSC	JPL	JSC	LaRC	GRC	MSFC	SSC
1) awards & recognition	5	2	2	0	3	2	2	2	0	0
2) # of hits	500K	150K	160K	50K	310K	215K	230K	220K	50K	50K
3) # of activities	5	2	2	0	3	2	2	2	0	0
4) # of papers	5	2	2	0	3	2	2	2	0	0
5) # of schools	150	59	48	19	93	65	60	66	19	19

7.7 LT Reports

The Project-reportable metrics selected below represent how well the respective projects are doing toward producing the desired results identified in the table of outcomes listed above. The table below specifies the data collection methodology and responsibility. This information will be recorded at the Project Office level.

The Project Office will also routinely report results or unusually successful (or unusually unsuccessful) efforts to the HPCC Program Office and other senior management. The Learning Technologies Project Office will be responsible for taking any necessary follow-up action as required. Task contributions and results will be among the criteria used by the Project Office in determining future budget allocations for proposals that are competed between Centers.

Table 7: LT Metrics and Data Collection for all Levels

Metric	Data To Be Reported Monthly
• Amount of awards or recognition received	• Each task reports new awards to its respective Manager
• On-line: Web statistics (hits, Kb transferred, unique addresses) per month	• Each task reports hit and domain statistics to its respective Manager (alternatively, this can be collected by RSPAC)
• Off-line: Number of conferences and other external activities	• Each task reports type of conference participation and demographic make-up to its respective Manager
• Number of “referenceable” papers submitted	• Each task reports numbers and type of

by LT and affiliates	collaboration to its respective Manager
• Number of schools and underserved schools served by LT projects	• Each task reports school name, location, and point of contact to its respective Manager (alternatively, this can be collected by RSPAC)

The LT will all report directly to EDCATS in addition to all other requirements.

7.8 Task Metrics for Grants and Cooperative Agreements

These milestones represent subtask requirements as determined by procurement and listed in the awarded grants and cooperative agreements. The metric for success is meeting all milestones on schedule. For example, most grants are only required to produce a report at the end of each grant year while cooperative agreements typically have several specific milestones to be accomplished during the course of the agreement.

7.9 LT Financial Metrics

All Learning Technologies Projects will work with financial accounting to track commitments, obligations and accruals. At a minimum, LT tasks and subtasks shall maintain metrics that track progress in meeting Office of Aerospace Technology budget performance requirements. These requirements are that there be 83% accrual and 100% obligation of FY funds by the end of September. In addition, it is required that there be 100% accrual of funds by the end of the calendar year. Line organizations at each NASA field center are responsible for meeting or exceeding these performance targets.

8. RESOURCES

8.1 Financial

Funding and workforce budgets have been coordinated among the various NASA centers participating in LT. The LT budget profiles for the fiscal years FY00 - FY05 are shown in the following table in millions.

Table 8: LTP Multi-Year Budget Plan

FY	Amount	Code FE
2000	$ 3.8 M	$ 3.8 M
2001	$ 4.0 M	$ 4.0 M
2002	$ 4.0 M	$ 4.0 M
2003	$ 4.0 M	$ 4.0 M
2004	$ 4.0 M	$ 4.0 M
2005	$ 4.0 M	$ 4.0 M

Table 9: LT 506 Authority Plan for Fiscal Year 2000

Center	Description	Task Breakdown	**Guideline**
ARC	HPCC Program Office	$120,000	
ARC	Technology Development	$225,000	
ARC	Project Office	$200,000	
ARC	Strategic Tasks	$50,000	
ARC	ROC ICWG Management	$80,000	
ARC	LT Annual Conference	$20,000	
ARC	ROC	$500,000	
ARC	KSC ROC	$42,000	
ARC	GSFC LEARNERS	$42,000	
ARC			**$1,279,000**
GSFC	LEARNERS Solicitation	$1,128,000	
GSFC	ROC	$160,000	
GSFC			**$1,288,000**
DFRC	ROC	$150,000	**$150,000**
JSC	ROC	$215,000	**$215,000**
JPL	ROC	$310,000	**$310,000**
LaRC	ROC	$230,000	**$230,000**
GRC	ROC	$220,000	**$220,000**
SSC	ROC	$50,000	**$50,000**
KSC	ROC	$8,000	**$8,000**
MSFC	ROC	$50,000	**$50,000**
	HPCC Learning Technology		**$3,800,000**

Further detail is available in section 6.

Table 10: LT Budget Plan for Fiscal Years 2000 – 2005

Learning Technologies Project Budget		FY00	FY01	FY02	FY03	FY04	FY05
ARC	HPCC Program Office	$120,000	$120,000	$120,000	$120,000	$120,000	$120,000
ARC	Technology Development	$225,000	$225,000	$225,000	$225,000	$225,000	$225,000
ARC	Project Office	$250,000	$250,000	$250,000	$250,000	$250,000	$250,000
ARC	ICWG Management	$80,000	$80,000	$80,000	$80,000	$80,000	$80,000
ARC	LT Annual Conference	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000
ARC	KSC ROC	$42,000	$42,000	$42,000	$42,000	$42,000	$42,000
ARC	GSFC LEARNERS	$42,000	$42,000	$42,000	$42,000	$42,000	$42,000
GSFC	LT New Solicitation	$1,128,000	$1,328,000	$1,328,000	$1,328,000	$1,328,000	$1,328,000
ARC	ROC (Traicoff)	$500,000	$500,000	$500,000	$500,000	$500,000	$500,000
GSFC	ROC (Fisher)	$160,000	$160,000	$160,000	$160,000	$160,000	$160,000
DFRC	ROC(McCarthy)	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000
JSC	ROC (Shelton)	$215,000	$215,000	$215,000	$215,000	$215,000	$215,000
JPL	ROC (Clark)	$310,000	$310,000	$310,000	$310,000	$310,000	$310,000
LaRC	ROC (Seaton)	$230,000	$230,000	$230,000	$230,000	$230,000	$230,000
GRC	ROC (Galica)	$220,000	$220,000	$220,000	$220,000	$220,000	$220,000
SSC	ROC (Powe)	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000
KSC	ROC(Buckingham)	$8,000	$8,000	$8,000	$8,000	$8,000	$8,000
MSFC	ROC(Anderson)	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000
Total		$3,800,000	$4,000,000	$4,000,000	$4,000,000	$4,000,000	$4,000,000

The budget numbers represent totals for the performing centers and cooperative agreements.

8.2 Workforce

The direct civil service (CS) workforces committed by the NASA centers to the program are shown in the following table in full-time equivalents (FTE).

Table 11: LT Workforce Plan by Fiscal Year Rounded to Whole Numbers

Center	FY00 Civil Service	FY01 Civil Service	FY02 Civil Service	FY03 Civil Service	FY04 Civil Service	FY05 Civil Service
ARC	3	3	3	3	3	3
DFRC (0.1 FTE)	0	0	0	0	0	0
GSFC (0.1 FTE)	0	0	0	0	0	0
JPL No Civil Service	0	0	0	0	0	0
JSC	1	1	1	1	1	1
KSC (0.1 FTE)	0	0	0	0	0	0
LaRC (0.4 FTE)	0	0	0	0	0	0
GRC	2	2	2	2	2	2
MSFC (0.1 FTE)	0	0	0	0	0	0
SSC (0.1 FTE)	0	0	0	0	0	0
Total	6	6	6	6	6	6

8.3 Procurement Strategy

Procurement will be in accordance with normal procedures for R&D activities at the procuring centers. Competitive procurements will be used to the maximum extent practicable. Among the procurement vehicles which are expected to be utilized on the HPCC Program are Performance Based Contracts, Grants, NASA Research Announcements, Cooperative Agreements, Fixed Price hardware purchases and leases, and cooperation with other Federal agencies.

8.4 Proposal Procedure for FY01

The points below refer to regional center proposals for FY01.

The procedure below allows for corrective action, enhancing integration, targeting projects, and avoiding duplication.

- Each center proposes for next fiscal year (LT and Education coordinate)
- Project Office reviews/filters to align with LT goals
- InterCenter Working Group (ICWG) conducts peer review
- AECC conducts review of any project containing an Aero Component
- Project Office and Educational Project Office Liaison approve proposal
- Following approval, money will be allocated by either 506 authority from HQ or subauthorization from ARC.

8.5 Principles of Proposal Process FY01

Joint signatures by the NASA Officer of Education and LT will be required where there is fiscal sharing or in-kind support provided by the Education Office. A concurrence signature by the Education Office is required for all other proposals.

9. CONTROLS

Commercially sensitive information that is generated under formal cooperative research agreements between NASA and non-Federal parties is protected by the amended (October 1992) NASA Space Act of 1958. Data produced under such an arrangement will be protected from Freedom of Information Act (FOIA) requests for a period of 5 years after the date of dissemination.

NASA center management, working with industry and NASA LT researchers, is responsible for identifying sensitive technologies. These technologies are handled in such a way that their dissemination to foreign companies, laboratories, and universities is restricted. The LTPO will adopt conventional security techniques.

Negotiated License Agreements are used to restrict access to privately developed technology performed under the auspices of the NASA LTPO. These agreements provide NASA with limited rights to use proprietary data or designs in NASA in-house or cooperative research projects. These agreements specify limits on the distribution and use of the proprietary data by NASA and NASA-licensed entities.

Some software and information developed within the NASA LTPO may be subject to protection under the Export Administration Regulations (EAR) or the International Traffic in Arms Regulations (ITAR), which are export controls established by law. The participants in the HPCC Program will follow applicable export control laws. These regulations establish lists or categories of technical data and/or products that may not be exported without an approved export license. (Note that the definition of "exported" includes "disclosed" and "discussed" as well as published.)

10. IMPLEMENTATION APPROACH

The work breakdown structure for LT has been defined to have a management component and four major elements as defined in section: 1) Learning Technologies Project Office; 2) Regional Outreach Centers; 3) LEARNERS; 4) Strategic Tasks; and 5) Technology Development. Please see section 5.4 for more details on the WBS.

10.1 NASA Field Center Responsibilities

Table 12: Field Center Support by NASA Enterprise

NASA Enterprise	Centers Supporting this Work
• Earth Science (ES)	• GSFC, JPL, JSC, LaRC, MSFC, SSC
• Office of Space Science (OSS)	• ARC, GSFC, JPL, JSC, LaRC
• Human Exploration and Development of Space (HEDS)	• ARC, JPL, JSC, KSC, LaRC
• Office of Aerospace Technology (OAT)	• ARC, DFRC, JSC, LaRC, GRC

Table 13: Approximate Field Center Support by NASA Center

Center	OES	OSS	HEDS	OAT
ARC	0%	25%	50%	25%
DFRC	0%	0%	0%	100%
GSFC	50%	50%	0%	0%
JPL	25%	50%	25%	0%
JSC	25%	25%	25%	25%
KSC	100%	0%	0%	0%
LaRC	25%	25%	25%	25%
GRC	0%	0%	0%	100%
MSFC	100%	0%	0%	0%
SSC	100%	0%	0%	0%

11. ACQUISITION SUMMARY

Free and open competitive procurements will be used to the maximum extent possible. Among the procurement vehicles expected to be put to use by LT are NASA Research Announcements (NRA), NASA Cooperative Agreement Notices (CAN), and Request for Proposals (RFP). These vehicles will result in grants, cooperative agreements and

contracts. Cooperative Agreement Notices (CAN) will be used to the maximum extent possible for the incorporation of technology and applications into the Program. Interagency agreements for joint R&D endeavors and the utilization of early prototype systems will also be used. As a result, many of the projects funded through these agreements reach out to the disadvantaged and underserved.

12. PROGRAM/PROJECT DEPENDENCIES

12.1 Cooperation with Other NASA Programs

LT maintains a liaison with NASA's other education programs, including the Education Division Offices residing at NASA field centers and the Education Division at NASA Headquarters. An LT Educational Liaison position has been created to ensure that all Learning Technologies educational products created out of LT will be coordinated with NASA's Education Division.

Frequently LT is required to implement technical demonstrations to high level VIP's. Code FE has demonstrated a dependency on LT to execute such events on short notice.

12.2 Cooperation with Other Organizations

A key concept of LT is early and continuing interaction with, and involvement of, the domestic academic communities. LT will actively foster this relationship through workshops, periodic in-depth reviews, and planning and review activities, as appropriate. These workshops and review activities are designed to elicit direct, unfettered feedback from some of the nation's best experts in the field of scientific education in primary, secondary and post-secondary educational environments regarding the goals, objectives, priorities and structuring of the programs planned under LT.

LT has established an Advisory Board consisting of key individuals in the domestic academic communities. This Planning and Review Team will meet at least annually in coordination with the LT budgeting and planning process but will be consulted and kept informed regularly.

Table 14: Interaction with Other Organizations, Excluding School Partnerships

Center	**Major Liaison Activities**

Project Office	• Access America Board • DARPA (Advanced Research Projects Agency) • CoSN (Consortium of School Networking) • CUE (Computer Using Educators) • Department of Commerce • Department of Defense • Department of Education • Department of Energy • Eisenhower National Clearinghouse • ISTE (International Society for Technology in Education) • ISOC (Internet SOCiety) • NCTM (National Council for Teachers of Mathematics) • NEA (National Education Association) • NHU (National Hispanic University) • NII (National Information Infrastructure) • NSF (National Science Foundation) • NSTA (National Science Teachers Association) • NetDay Committee
ARC	• California State Teachers Association (CSTA) • US Department of Education • The JASON Project • The Discovery Channel • SpaceNews • GTE/Americast • Institute for Computer Technology • The GLOBE Program • Other California state & local education organizations
DFRC	• California State
GSFC	• Maryland State
JSC	• Clear Creek School District • Texas Education Network (TENET) • Other Texas state & local education organizations • Mississippi State University (Research, Rehabilitation, & Training - Center on blindness and low vision)

JPL	• Los Angeles County Office of Education (LACOE) • The California State Department of Education Science Framework Committee • California Museum of Science and Industry, Los Angeles, CA • California State • Mitsubishi • Air Touch • Software Bisque • Mount Wilson Institute • Naval Observatory • Celestron • Mead Instruments • Santa Barbara Instruments Group • Silicon Graphics • Boston Museum of Science • Little Thompson Science Foundation • Hayden Planetarium • Griffith Observatory
KSC	• Florida state and local education organizations • Florida Gulf COAT University • Florida State Commissioner of Education
LaRC	• Virginia state & local education organizations • Elizabeth City State University • US Department of Housing and Urban Development • Virginia Space Grant Consortium • Unified Research Laboratories • WHRO Public TV
GRC	• Ohio state • Ohio Space Grant Consortium, • WVIZ-TV (Cleveland Public TV)
MSFC	• Alabama state & local education organizations
SSC	• Mississippi state & local education organizations

13. AGREEMENTS

LT utilizes Interagency Agreements (IA), Memorandums of Understanding's (MOU), and other NASA mechanisms for accomplishing work with other parties.

Internal agreements:

LT maintains agreements between NASA HQ Code F, NASA ARC Code IC, and HPCC's NREN Project. All of these projects involve leading-edge Internet communications technology to support educational requirements.

External agreements

LT is expected to maintain a presence on the CCIC Educational Training and Human Resource (ETHR) working group. Currently LT is responsible for maintaining a Web site for this group.

Currently LT maintains certain Letters of Intent between local schools for specific opportunities through the end of FY00. These letters are with Broadway High School, San Jose, California and Foothill High School, San Jose, California. In addition to these two high schools, LT maintains an ongoing relationship with East Palo Alto School, Ronald McNair, as a result of an MOU signed in 1995 between the Administrator and the school.

A Space Act Agreement between NASA GRC and the Educational Television Association of Metropolitan Cleveland (WVIZ-TV) for the creation of a NASA Educational Channel on an Instructional Television Fixed Services Channel was signed July 27, 1998.

14. PERFORMANCE ASSURANCE

LT will work with industry, academia and other federal agencies to assure the quality of their products.

14.1 General

LT will leverage off its relationship with the Educational Training and Human Resources working group to debut new technologies.

14.2 Reliability

Each task is responsible for utilizing evaluation mechanisms on their deliverables such that all software and interactive systems are 95 percent reliable. For example the multimedia backbone will be operational 19 attempts out of 20.

14.3 Quality Assurance

The NASA Education Division and the intercenter working group will have the opportunity to review all data content and assure 100 percent accuracy in all NASA data.

14.4 Performance Verification

LT will utilize the ICWG as the primary source of performance verification and the LT Advisory Board as the secondary source of performance verification.

14.5 Software Assurance

LT will utilize the ICWG as the primary source of performance verification and the LT Advisory Board as the secondary source of performance verification.

14.6 Maintainability

It is the requirement of LT that all project software is supported and easily maintainable by the end user. A primary requirement is that the software be easily replicable and inexpensive for the user to run on typical desktop systems.

15. RISK MANAGEMENT

Responsible risk assessment must be made of all new technologies disseminated into all formal and informal learning environments.

15.1 Overview

In the development of technology, risk arises from unexpected developmental difficulties. LT was planned with a portfolio of risk versus payoff. While the minimum success criteria are expected to be achieved, there are some high-risk, high-payoff elements in LT. Milestones have been designed with the probability that they can be achieved.

15.2 Technical Risk

NASA's LT mission requires currency with the leading edge of technology and a direction that is consistent with the future. To minimize the potential risk of investing resources in the wrong technology, NASA frequently meets with industry and other Federal agencies to help plan the future of the technology.

Systems software developed to date is built on conventional personal computers and similar architectures. To minimize the risks of software development, NASA is leading efforts to pool the resources of multiple government agencies and strengthen collaborative efforts with industry and academia.

It is critical that NASA continues to pursue a quick and responsive procurement mechanism for acquiring experimental software that is compatible with the user community. To minimize the potential risks, NASA has developed in-house procurement vehicles that permit rapid vendor responses. NASA also partners with other Federal agencies to leverage off other procurement vehicles.

As a partner in an overall Federal program wherein high-risk research is shared by other participating federal agencies, NASA portions of jointly-sponsored research initiatives are often dependent on funding and work commitments made by partner institutions. This risk is mitigated through cooperative planning with the other agencies to ensure a cohesive plan with no unforeseen consequences.

The detailed technical risks of the project are encapsulated in the various sub-projects. The project technical risks are shown in the table below.

Table 15: Technical Risk Assessment

Risk (probability without mitigation)	Impact	Mitigation
• Educational Community requirements change (low)	• Products do not meet customer requirements • Reduced technology transfer success • Increased customer efforts required to adapt products (medium)	• Track the development of National and State standards to insure that the technology developed by LTP is consistent with any changes in the educational community.
• Educational projects do not meet expected interactive performance (medium)	• Reduced benefit at user level (high)	• Assign Task Managers to access their technology platforms annually with educational capabilities and industrial development trends to insure that LTP products will exceed or meet interactive performance requirements.
• Duplication of Process by another federal agency (high)	• Inefficient use of program resources • Valuable project activities not funded (low)	• Utilize interagency forums more efficiently through the use of LTP liaisons with various Federal Agencies such as NSF, DOE, DoEd, DARPA, and the DOD.

To help understand and mitigate technical risk at the LT level, LT is monitored on a regular basis by specialists external as well as internal to NASA. In addition to the regularly scheduled reviews, the overall LT project and each individual task have technical working groups to bring external peer-reviewed input to the technical activities.

15.3 Resource/Schedule Risk

NASA's LT software and network testbeds are critical to ensure the future success of NASA's Education Division, Educational Technology goals. LT partners with other Federal agencies and industry to use their facilities when necessary. LT has established an allocation and scheduling system for its testbeds that ensures best possible use of the facilities. Additionally, LT is pursuing more cost-effective means of providing versatile testbeds for the future.

Risk in LT is managed primarily through the manipulation of inputs. In the event that schedules may not be met, greater resources may be deployed to compensate schedule problems. These resources would be redirected from lower-priority task milestones or from tasks that have achieved their milestones ahead of schedule.

The Table below presents an overview of the overall resource/schedule risks faced by LT, their potential impact, and the mitigation actions either taken or to be taken by the Project.

Table 16: Resource/Schedule Risk Assessment

Risk (probability without mitigation)	Impact	Mitigation
• Educational Products overtake NASA development (medium)	• Project activity descoped • Resources are wasted (low)	• Conduct a cancellation review on task. • Implement modified design to leverage off of unique elements that will not be overtaken. • Formal joint corrective action teams
• Reduction/loss of funding (high)	• Reduced TRL for program products • Near-term milestones delayed or descoped with long-term milestones descoped or eliminated • Project or element terminated with loss of benefits (high)	• Advocate benefits to customers/stakeholders • Re-plan based on project descope priorities • Re-plan based on program descope priorities

16. ENVIRONMENTAL IMPACT

There are no environmental impacts generated by this project.

17. SAFETY

Standard safety regulations are maintained by all NASA civil servants and contractors as required by the individual field centers and Principle Investigator (PI) locations.

18. TECHNOLOGY ASSESSMENT

LT is an education technology and applications project that pursues technologies that are between five and twenty years of maturity. Applications in the areas of K-12 education, the four NASA enterprises, and HPCC project areas are used as drivers of LT's technology research, providing the requirements context for the work that is done. These applications are generated from NASA engineers working with industry to develop capabilities and features that will drive the next generation of technology. As the technical capability of hardware and networks is challenged, the applications will be used to achieve project objectives.

LT conducts research activities intended to prove feasibility, develop and demonstrate educational technologies for eventual introduction into NASA's Education Program. In addition, LT conducts education technology outreach demonstrations that are essentially at Technology Readiness Level (TRL) 7-8. Note that LT engages in technology that is initiated at TRL-1.

19. COMMERCIALIZATION

Commercialization opportunities will be exploited through Space Act Agreements, Cooperative Research Agreements and Memoranda of Understanding with industry. Joint projects in high-risk areas will be pursued on a cost-sharing basis with industry and in close collaboration with government laboratories and academia. NASA will foster horizontal partnerships between NASA and multiple companies within the aerospace sector. The NASA LT Project Office will also foster the vertical integration of collaborative teams between hardware suppliers, third-party software vendors, and members of the U.S. aerospace community. Lastly, the LT Project Office sponsors and conducts technical meetings and workshops and promotes the publication of scientific and technical papers to maintain the flow of technology from NASA to industry and academia.

20. REVIEWS

The LT manager and Deputy Project Manager will submit reports on a regular basis and hold reviews periodically to evaluate technical and administrative progress on LT.

Comprehensive program reviews are conducted to evaluate the progress of the project and give critical feedback to the project managers. In addition to appropriate NASA personnel, representatives from other federal agencies, academia and industry may be invited to participate. Reviews are conducted in accordance with established policies and procedures.

20.1 Reviews

LT has four primary reviewing entities. The strongest is the Advisory Board which meets once a year to review all of the projects and provide guidance. In addition, the advisory board reviews all of the project plans prior to their approval in the management plan. The second most influential review is the annual review. The whole LT contingent meets to discuss and review the project. The third reviewing agent is the InterCenter Working Group. This panel meets once every two months to collaborate and exchange views on the status of project development. It is an open forum designed to improve the LT product. The fourth review process is conducted once every two weeks by the immediate LT management whereby projects are assessed and corrected where necessary

The Regional Projects are responsible for regular review of their agreements and subtasks by the appointed technical liaisons. This should be handled in the form of regular telecons and at least one site visit per year. The LT Office will conduct at least one review of each cooperative agreement and grant.

20.2 Reports

All elements and projects are responsible for providing monthly and annual project reports. Centers with ROC subtasks are required to provide the information necessary for these reports on time. All projects will be required to provide information for the LT Annual Report. All types of data may be requested

21. TAILORING

The HPCC Program will be managed and implemented in accordance with the normal procedures used by the Aerospace Technology Enterprise for Systems Technology Programs. There are no major deviations from these procedures.

22. CHANGE LOG

Changes to LT since inception in 1993:

1. December 1992. HPCC IITA K-12 Project initiated
2. June 1993. HQ makes ARC lead Center for IITA K-12 Project
3. May 1995. HQ moves IITA Project Office to ARC
4. March 1996. Out-year milestones. Eliminated IITA milestones due to funding cuts.
5. September 1997. IITA project ends due to funding cuts.
6. October 1997. LT Project initiated. IITA education activities and milestones transferred to LT.
7. PCA update April 2000

23. REFERENCES

- 1999 LTP Annual Report
- 1999 LTP Product Guide
- 1998 LTP Product Guide
- 1998 LTP Annual Report
- 1998 LTP Five-year Plan for Education
- 1997 IITA Annual Report
- 1997 IITA K-12 Education Proposal Plan
- 1996 NASA Communicating Science, A Celebration of Accomplishments
- 1996 NASA Communicating Science, A Celebration of Accomplishments (Second Printing)
- 1996 K-12 Outreach Proposal Plan
- 1996 IITA Products Guide

- 1996 IITA Annual Report
- 1996 IITA K-12 Annual Report
- 1995 K-12 Outreach Proposal Plan
- 1995 The High Performance Computing and Communications Information Infrastructure Technology & Applications K-12 Internet Education Project Program Evaluation Report October 1995
- 1995 IITA K-12 Annual Report
- 1995 IITA K-12 Evaluation Report Briefing to L. Holcomb at NASA HQ November, 1995
- 1994 High Performance Computing and Communications: Technology for the National Information Infrastructure. Supplement to the President's Fiscal Year 1995 Budget
- 1994 Learning Technologies: A Report to the HPCCIT LT Task Group. January 4, 1994
- 1994 IITA K-12 Annual Report
- 1993 The National Information Infrastructure: Agenda for Action, the Information Infrastructure Task Force. September 15, 1993

24. ACRONYMS

AECC	Aeronautics Education Coordinating Committee
AIRNet	Alabama Internet, Inc.
ARC	Ames Research Center
AREN	Alabama Research and Education Network
ASCD	Association for Supervision for Curriculum Development
DARPA	Advanced Research Projects Agency
CAN	Cooperative Agreement Notice
CCF	Community College Foundation
CCIC	Committee for Computing, Information and Communication
CNES	French Space Agency
CO	Contract Officer
COSN	Consortium of School Networking
CoTF	Classroom Of The Future
COTR	Contracting Office Technical Representative
CS	Civil Service
CUE	Computer Using Educators
DoE	Department of Energy
DFRC	Dryden Flight Research Center
EDCATS	Educational Division Computer Aided Tracking System
EL	Enterprise Liaison
EOS	Earth Observing System
ESE	Earth Science Enterprise
ETHR	Educational Training and Human Resources
EWG	Evaluation Working Group
FTE	Full Time Equivalents
FY	Fiscal Year
GSFC	Goddard Space Flight Center
HEDS	Human Exploration and Development of Space
HPCC	High Performance Computing and Communications
HQ	Headquarters
ICWG	InterCenter Working Group
IITA	Information Infrastructure Technology and Applications
ISOC	Internet SOCiety

ISTE	International Society for Technology in Education
ITEA	International Technology Education Association
JPL	Jet Propulsion Laboratory
JSC	Johnson Space Center
K-12	Kindergarten through 12th grade
KSC	Kennedy Space Center
LaRC	Langley Research Center
LEARNERS	Leading Educators to Applications, Research and NASA-unique Educational Resources in Science
GRC	Glenn Research Center
LT	Learning Technologies
LTC	Learning Technologies Channel
LTP	Learning Technologies Project
MOU	Memorandum of Understanding
MSG	Multimedia Streaming Group
MSFC	Marshall Space Flight Center
MTO	Mars Team Online
NASA	National Aeronautics and Space Administration
NECA	National Education Computing Association
NECC	National Education Computing Conference
NII	National Information Infrastructure
NRA	NASA Research Announcement
NSF	National Science Foundation
NSTA	National Science Teachers Association
OAT	Office of Aerospace Technology
OSS	Office of Space Science
OtH	Over the Horizon
PCA	Program Commitment Agreement
PI	Principal Investigator
PO	Project Officer
R^2	ROVer Ranch
RFP	Request for Proposal
ROC	Regional Outreach Center
RSPAC	Remote Sensing Public Access Center
SEWG	Special Events Working Group
SIMON	School Internet Manager Over Networks

SOMO	Space Operations Missions Office
SPACE	Sun, Planets, Asteroids, Comets, Exploration
SSC	Support Service Contractors
SSC	Stennis Space Center
STO	Space Team Online
TIE	Telescopes in Education
TRL	Technical Risk Level
UPN	Universal Project Number
U.S.	United States
USFIRST	U.S. For Inspiration and Recognition of Science and Technology
VSM	Virtual Science Mentor
WBS	Work Breakdown Structure
WELES	Web-Enhanced Learning Environment Strategies